LETTERS TO THE EDITOR.

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The Royal Society.

AT the special meeting of the Royal Society held on January 21, when the constitution and functions of the sectional committees were under consideration, the opinion was expressed by more than one speaker that the usefulness of the society in encouraging and advancing scientific work is not what it might be; but no very definite suggestions were made with a view to its improvement.

It seemed to me that the functions of these sectional committees had a good deal to do with the lack of scientific enterprise which we observe in the Royal Society, and that they might with advantage be done away with.

As many of the fellows had left the meeting before I spoke, and as everything that affects the efficiency of the Royal Society concerns the public, I crave the hospitality of the columns of NATURE to develop as shortly as possible my views on this matter.

The main function of the sectional committees is to *refer* papers received by the society from fellows, to some other fellow or fellows of the society to be certified that they are or are not fit to be accepted and published by the society.

It is well known that the fellows of the society are *de facto* chosen by the council after rigid scrutiny and the most careful inquiry, and the only object of this scrutiny and inquiry is to satisfy the council that the candidate whom it recommends is a man of eminence in his own science, and that the work which he is likely to do will be a credit to the society. So convinced is the society of the thoroughness and impartiality with which the council discharges this duty that the confirmation of its selection by election has come to be a pure formality. This being so, it cannot fail to surprise the newly elected fellow, when he proceeds to justify his election by doing work and communicating the results of it to the society, to find that he is now in no better position than he was before he was elected. His work is *referred* in the same way as that of any outsider. His recent selection by the council is ignored by that body or is regarded as having no weight, and it treats him, scientifically, as a perfect stranger.

Furthermore, this *reference*, which amounts to neither more nor less than a secret revision of the title of the fellow to the privileges of the society, is repeated on every occasion when he comes under the notice of the society by offering it work. So long as he is content to be a passive fellow, or at least an inactive one, he is spared this injustice and indignity. It is no wonder then that the fellowship of the Royal Society has come to be looked on as an invitation to repose rather than as an incentive to work.

How different is the state of things which we observe in the parallel society in France, the Academy of Sciences. Its constitution is thoroughly democratic, and all its proceedings are inspired by enlightened self-respect. But we need only contemplate the work which it puts through in the year and compare it with what is turned out by the Royal Society to see that there is something for us to learn by its study.

First and foremost the academy meets fifty-two times in the year, namely, on every Monday, with the exception of Easter Monday and Whit Monday, and then it meets on the following Tuesdays. By the time-table of the current year the Royal Society is to meet twenty times.

Papers by members, or communicated by members of the academy, are not obliged to be sent in before the meeting. The *agenda* of the meeting is compiled at the meeting, each member who has a paper to communicate giving notice of it to the secretary on his arrival in the room, and the papers are taken strictly in the order of their intimation. If the paper communicated by the member is to be published in the *Comptes rendus* of the sitting, it has to be handed in to the secretary at the sitting; the corrected proof has to be returned to the printer on the Wednesday evening, and it is then published without fail on the Sunday. The communication, reading, and publication of a paper presented to the academy is therefore an affair of the inside of a week, and it is a certainty. This promptitude in the putting through of work is due to the fundamental fact that when a man is elected a member of the academy he enters at once into the full enjoyment of all its privileges, and one of the chief of these is the complete confidence of all his fellow-members. When he communicates a paper, whether it be by himself or by someone not a member of the academy, it is accepted without question. The only limitation in the privileges of members is with regard to the space that they are entitled to claim in the *Comptes rendus*. A paper by a member or foreign associate of the academy may fill six pages per number, and his communications in the year may fill fifty pages in all, and this as a matter of right.

It is unnecessary to occupy more space in order to show what a powerful engine the Academy of Sciences is in the production and encouragement of work, or to indicate how easily the Royal Society may successfully rival it. Let every fellow of the society, whether he be on the council or not, have complete confidence in his fellow-fellows and give practical effect to it, and the thing is done. The rest will follow of itself.

J. Y. BUCHANAN.

January 23.

The Radiation from an Electron describing a Circular Orbit.

THE complete formula for the radiation may be useful to some of those who are now indulging in atomic speculations. It is derived from the general formula I gave a year ago in NATURE (October 30, 1902), expressing the electromagnetic field everywhere due to an electron moving anyhow. Put in the special value of R required, which is a matter of elementary geometry, and the result is the complete finite formula. But only the part depending on R^{-1} is required for the radiation; and, in fact, we only want the r^{-1} term (if r=distance from the centre of the orbit), if the ratio of the radius of the orbit to the distance is insensible, and that, of course, is quite easy, on account of the extreme smallness of electronic orbits. The magnetic force is given by

$$H_\phi = \frac{Qun}{4\pi rv}\alpha^3 \cos\theta \cos\phi_1, \qquad (1)$$

$$H_\theta = \frac{Qun}{4\pi rv}\alpha^3(\sin\phi_1 - \beta), \qquad (2)$$

subject to

$$\alpha = \frac{1}{1-\beta\sin\phi_1}, \quad \beta = \frac{u}{v}\sin\theta, \qquad (3)$$

$$\phi_0 = \phi_1 + \beta\cos\phi_1 = \phi - nt + nr/v. \qquad (4)$$

There is no limitation upon the size of u/v, save that it must be less than 1. But there is a limitation regarding the acceleration. If the change in the acceleration is sensible in the time taken by light to traverse the diameter of the electron, it will sensibly alter the results. The size of the electron itself will then have to be considered. But this is very extreme. To explain the symbols: the (surface) charge is Q moving at speed u and angular speed n in a circle in the plane perpendicular to the axis from which θ is measured. It revolves positively round this axis, and its position when $t=0$ is $\phi=0$. Also, r, θ, ϕ are the usual spherical coordinates of the point of observation, and H_ϕ. H_θ are the ϕ and θ components of the magnetic force at that point at the moment t. The coefficient α^3 shows the Doppler effect on **H**. The difference between ϕ_0 and ϕ_1 must be noted.

It will be readily seen what an important part the Doppler effect plays if, as has been sometimes assumed, subatomic motions of electrons involve values of u which are not insensible fractions of v. For instance, in the plane of the orbit, $H\phi=0$, and

$$H_\theta = \frac{Qun}{4\pi rv}\frac{\sin\phi_1 - u/v}{[1-(u/v)\sin\phi_1]^3} \qquad (5)$$

The effect is to compress H in one half and expand it in the other half of a period, with corresponding strengthening and weakening of intensity, and also with a shifting of the nodes towards the compressed part. When u/v is made large, there is a great concentration at $\phi_1=\phi_0=\frac{1}{2}\pi$, $2\frac{1}{2}\pi$, $4\frac{1}{2}\pi$, &c., with only a weak disturbance of opposite sign between them. That is, there is a tendency to turn the original simply periodic vibration into periodic pulses, which become very marked as u increases towards v. The radiation of energy is very rapid. It involves (*l.c.*) the factor $(1-u^2/v^2)^{-2}$. This becomes so great as seemingly to shut out the possibility of anything more than momentary persistence of revolution. But there might be a solitary partial revolution, or nearly complete, in cometary fashion, which would generate a single pulse, if there cannot be a sequence of several at speeds nearly equal to that of light.

Three suggestions have been made about the X-rays. Röntgen suggested a longitudinal ether disturbance. This has not found favour, because it requires a new theory of electricity. Schuster suggested very rapid vibrations. This is tenable, because in the inside of an atom rudimentary calculations show that vibrations much more frequent than light are easily possible with revolving electrons. Stokes suggested collisional pulses. This is tenable too, for the collisions must produce electromagnetic pulses. I think X-rays are mixed Stokes pulses and Schuster vibrations, the latter arising from the atoms of the body struck. Now a pulse is not the same as a continued vibration, though it may be analysed into the sum of various sorts of continued vibrations, just as the distorted simply periodic vibration in (5) above may be. There ought, then, to be a physical difference between the effects of collisional pulses and continued very rapid vibrations. Apart from the emission of electrons and matter, there might be six sorts of radiation at least, say, light vibrations, below light, above light, collisional pulses, cometary pulses, and possibly periodic pulses. The last may have to be excluded for the reason mentioned. The cometary pulses would resemble the collisional pulses, though less dense. The above light vibrations need not require u/v to be more than a small fraction, though even then their maintenance is a difficulty. They require renewal again and again, perhaps in a collisional manner. There is a good deal to be found out yet in the relations of electricity to matter. There is also sometimes a good deal of misconception as to the relations of theory to fact. A purely dynamical theory of electricity, like Maxwell's, can give no information about the connection between electricity and matter. For example, Zeeman's experiment, as interpreted by Lorentz, brought out the striking fact that it was the negative electricity that revolved, not seemingly the positive, and the fact harmonises with J. J. Thomson's negative corpuscles. Theory could never predict such a fact, because it is not in the theory. It could not be there, because it has no dependence upon the dynamics of electricity in the theory. The same may be said of various other new facts much discussed of late. Now, though the theory cannot predict such facts, it is useful, of course, as a guide in framing hypotheses to account for the new facts, for it is no use flying in the face of solid theory. Whether the solid theory itself (not meaning that the ether is solid) will need to be altered remains to be seen. There is no sign of it yet, though I cannot believe the ethereal theory is complete.

To analyse the dopplerised vibrations expressed by (1), (2) into simply periodic vibrations seemed to involve very complicated work at first, save just for two or three terms. But there is a trick in it, which, when found, allows the complete expansions to be developed in a few lines. First show that (this is the trick)

$$\alpha^3\cos\phi_1=-\frac{d^2}{d\phi_0^2}\cos\phi_1,\quad \alpha^3(\sin\phi_1-\beta)=-\frac{d^2}{d\phi_0^2}\sin\phi_1. \quad (6)$$

Next, by the theorem known as Lagrange's, $\sin\phi_1$ can be at once put in the form of a series involving the derivatives of various powers of $\cos\phi_0$. Do not find the derivatives from them, but put $\cos^n\phi_0$ in terms of the sum of first powers of cosines by the well known circular formula. The full differentiations, not forgetting those in (6), may then be done at sight in one operation. The result is

$$\alpha^3(\sin\phi_1-\beta)=\sin\phi_0-\beta\,.\,2\cos 2\phi_0-\frac{3}{8}\beta^2(9\sin 3\phi_0+\sin\phi_0)$$
$$+\frac{4}{3}\beta^3(4\cos 4\phi_0+\cos 2\phi_0)+\frac{\beta^4}{\lfloor 4}\frac{1}{2^4}\Big(5^5\sin 5\phi_0+5\cdot 3^4\sin 3\phi_0$$
$$+10\sin\phi_0\Big)-\frac{\beta^5}{\lfloor 5}\frac{1}{2^5}\Big(6^6\cos 6\phi_0+6.4^4\cos 4\phi_0+15.2^4\cos 2\phi_0\Big)$$
$$-\ldots(7)$$

and so on to any extent. Then, to find the other one, differentiate the series in (7) with respect to ϕ_0 and divide the nth term by n. Thus

$$\alpha^3\cos\phi_1=\cos\phi_0+2\beta\sin 2\phi_0-\frac{\beta^2}{8}\Big(27\cos 3\phi_0+\cos\phi_0\Big)-\ldots(8)$$

and so on. This analysis of the vibrations is useful in some special developments, but of course the original distorted simple vibration is the most significant. In fact, the result of the analysis exhibits the common failing of most series developments that the resultant meaning is not evident.

Another way. Use Bessel's series for the sine and cosine of ϕ_1, and then carry out (6). It is remarkable that the relation between the eccentric and mean anomaly in a planetary orbit should be imitated, for the dynamics is quite different.

When I was a young child I conceived the idea of an infinite series of universes, the solar system being an atom in a larger universe on the one hand, and the mundane atom a universe to a smaller atom, and so on. I do not go so far as that now, but only observe that there is a tendency to make the electrons indivisible, and all exactly alike. But they must have size and shape, and be therefore divisible. Unless, indeed, they are infinitely rigid. Or they may vary in shape without dividing. There are infinite possibilities in the unknown. Kaufmann's measurements go to show that the mass of an electron, if there is any, is only a small fraction of its effective electromagnetic mass, although that is not a definite quantity subject to the Newtonian second law. But it is too soon to say that the electron has no mass at all, that is, to be quite sure that negative electricity is absolutely separable from matter, though it seems likely. It would be well to have, if possible, similar measurements made on positive electricity. If permanently attached to matter, it should not exhibit the increased inertia with increased speed in a sensible manner.

January 11. OLIVER HEAVISIDE.

Atmospheric Electricity.

YOUR correspondent Mr. George Simpson truly points out that the sun's α rays would be stopped by the upper atmosphere, whereas his β rays would penetrate much further; and perhaps he may have also noticed that an energetic separation of these oppositely charged rays would be effected by the earth's magnetic field, the negative being conveyed toward the poles, and the positive remaining near the tropics along with the maximum sunshine.

Consequently quadrantal earth-currents would be generated, and likewise a Leyden jar action would be set up in the tropical region of the lower atmosphere, sufficient to account for prevalent tropical thunderstorms. Some magnetic perturbations could also be accounted for.

OLIVER LODGE.

Nomenclature and Tables of Kinship.

A CIRCULAR letter, arranged like the following, is about to be issued for carrying out certain inquiries into heredity, and I am anxious, before taking a more definite step, to have it criticised and to receive suggestions. I send it to NATURE not only for my own advantage, but because I think it will interest those readers who occupy themselves in analysing experiences in breeding animals of any kind, although this table has been specially designed to receive hereditary facts concerning man.

The processes that it is desired to facilitate are, in out-